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ABSTRACT

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Science Curriculum Development as Teacher Development:

A Descriptive Study of Urban School Change

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RUNNING HEAD: CURRICULUM AND TEACHER DEVELOPMENT

Abstract

The purpose of this study was to describe the curriculum development process in a large mid-western urban school district as it was perceived by the teachers involved in this project over a four year period. This study was conducted using qualitative methods, particularly participant observation, semi-structured interviews and written surveys. Three significant patterns emerged. First, teachers perceived curriculum primarily as content, but also as pedagogy. They stressed not only what should be taught but how content should be manipulated in science. Sccond, teachers described the process of curriculum development as emergent, and never complete. Third, teachers conceptualized the success of the project not only in terms of a written document, but in terms of the personal and staff development inherent in the collaborative, reflective nature of the process as they created and experienced it.

Science Curriculum Development as Teacher Development:

A Descriptive Study of Urban School Change

> In my view, if teachers are to believe in standards and want to implement them, then they need to *be there* . They need to participate in the conversations that produce the standards they seek to enact through their teaching (Smagorinsky, 1999).

Teachers are sometimes asked to develop or adapt curriculum, design programs, or engage in systemic school improvement processes that have as their goal the improvement of instruction and/or curriculum. Typically these projects are initiated to solve a problem (Sparks & Loucks-Horsley, 1990). This study seeks to describe the curricular change processes in an urban school district as perceived by the teachers involved in science curriculum revision initiated, in part, in a response to poor district performance on state mandated proficiency tests. The emergence of the design process will be attended to, in an effort to understand perceived successes and failures of this model of curriculum development as defined by these teachers. This is of particular relevance, as this district is constructing a standards-based curriculum based on national and state reform models, with the district-wide mission that all students meet and exceed its defined academic standards.

In addition, we are interested in science teachersí perceptions of "being there." What happens when teachers are involved, not only in implementing standards-based curriculum, but in articulating and defining the standards that all students are to meet? What do teachers learn when engaged in this discourse? How does this dialogue effect urban school change?

Ideas From the Literature

Curriculum Development

While even a survey of curriculum development models is beyond the scope of this paper, it is appropriate to cite some of the current thinking in the field. McNeil (1996) describes at least seven modes in his work, from the rational model which follows an orderly predetermined decision-making process, to student generated curriculum which derives its goals from personal background and experience. Glatthorn (1987) describes three ways in which teachers can modify a districtís curriculum guide. He recommends that these activities be done in groups, believing that teachers will become more cohesive and will share ideas about teaching and learning in general as well as ideas about the task at hand. Interestingly, Purves (1975) notes that while existing models are one way to frame the development process, these models donít tell a person how to proceed anymore than a blueprint tells how to build a house. Instead, he utilizes the metaphor of a game to describe the curriculum building process.

Rules for playing the game center on legal constraints and administrative structure. States have specific requirements as to what will be taught in schools, and administrators serve as leaders of pedagogy to some degree. Other pieces include local contexts: the interests and capacities of students, teachers, and the community. Purposes, materials, activities, evaluation all must be devised, but there is no "right" order to the game. Purves indicates that a player may start with any piece, as long as all pieces are picked up, are perceived in some relationship to one another, and that "winning" the curriculum game is a local decision.

Frey, Frey, & Langeeheime (1989) however, caution that there is some evidence that the curriculum development model utilized influences what is taught. They studied three models for creating a curriculum in mathematics and found that: 1) a naturalistic model with emphasis on subject matter as principle source resulted in a

traditional, academic curriculum; 2) a deliberative model that stressed student participation resulted in a variety of activities and in-depth study of a narrower range of content; and 3) a situational approach stressing real-life contexts resulted in a curriculum that favored content applications.

So, while the literature contains a plethora of curriculum development models, the consensus appears to be that the process is a local phenomenon to be informed by but not prescribed by research. Purves says, " A number have started with evaluation and built a dog to fit the tail." (pp.142). This may be what is occurring in many states in response to state-mandated proficiency tests, which students must pass to be promoted or to graduate. This emphasis on one mode of assessment of student progress may be the guiding principle of much curriculum work done today (Scholl & McQueen, 1985).

Standards and Curriculum Development

In the *National Science Education Standards,* the National Research Council (1996) suggests that their work in articulating national standards for all students should not be seen as requiring a specific curriculum. They define curriculum as "the way content is organized and presented in the classroom"(pp.3) and that their are many multiple ways to do so with different emphases and perspectives. Instead, the NRC proposes that their work serve as a benchmark as to whether local, state and national actions "serve the vision of a scientifically literate society." (pp. 3).

The Council calls for:

> Continuing dialogues between those who set and implement standards at the national, state, and local levels(that) will ensure that the *Standards* evolve to meet the needs of students, educators, and society at large. *The National Science Education Standards* should be seen as a dynamic understanding that is always open to review and revision (pp. 3).

In addition, the NRC proposes professional development standards for science teachers where professional learning activities are clearly and appropriately connected to teachersí work in the school context. In this way, teachers gain the concepts and skills necessary to implement standards-based education. Smagorinsky (1999) would argue that such professional development activities must include direct involvement in defining and articulating the academic standards they are to enact in their teaching. He perceives of the national standards movement as the *beginning* of a process that teachers need to be intensely involved in if they are to take standards seriously. Engagement in such a process can provide a transformative experience, where teachers become excited about the prospects for change, and committed to action.

As national, state and local educational reform efforts move toward standards-based systems committed to success for all, how does this affect curricular design at the local level? How does this affect teachers, and their classrooms? This investigation utilizes these theories of curriculum development and standards-based curriculum design as a local, constructive process to explore the curriculum work in one urban district.

The Context of the Study

This study takes place in a large mid-western urban school district, where over 70% of students are minority, and 50% meet the Title I definition of poverty. The district is in the midst of a major revision of curricula, a process occurring every five to seven years. In this current cycle, curriculum has been written in terms of standards for student performance termed promotion or credit granting standards. These are definitive statements as to what students should know and be able to do at a given level K-12, and in a given discipline in order to be promoted or given credit. The measure of this achievement is explicitly stated in a rubric designed for each credit granting standard, describing observable student performances indicative of achieving the standard at varying levels 1-4, with 2 being the minimal level of performance and 4 describing exceptional work. This mirrors the current reform efforts in many state model curricula, as well as national efforts such as work done by the National Council of Teachers of Mathematics (NCTM)(1989); and the National Research Council (1996). The science curriculum revision is unique, however, in that the work was funded in part through an Urban Systemic Initiative grant (USI) provided by and supervised by the National Science Foundation (NSF). The grant funded four of a five year cycle of curricular and staff development with yearly review. The fund was administered by central office personnel, with in-service provided by a core team of teachers removed from the classroom to function as facilitators of improvement in science teaching.

This grant and the activity it funded came at a time when this district was and is currently under great pressure to improve standardized test scores, specifically state proficiency test outcomes.

Methodology

This investigation was conducted using qualitative methods, particularly participant observation, written surveys, document analysis and the semi-structured interview (Glesne & Peshkin, 1992). It will also utilize Chi-Square tests (SPSSX, 1997) for qualitative data in analysis of part of the written survey results, to determine in which areas informants believe professional development occurred. The statistical tests will also suggest whether there was an interaction between depth of involvement in the curriculum initiative and teacher learning. Data were collected over a four year period.

Data Collection

Interviews were conducted with ten science teachers involved in curriculum revision, and with the lead science teacher responsible for K-12 science curricular revision through the USI grant, in year two and year four of the study. Draft documents of the curricula, in-service plans, and curriculum writing meeting notes from the four year period were reviewed. In addition, a survey (Appendix A) was sent to the science teachers directly involved in writing the science standards ($n = 36$) in year four. This survey asked for Likert scale responses to whether teachers felt their involvement in the initiative increased their knowledge in a variety of professional development areas. The areas studied were: Professional Knowledge, Collegiality, Instruction, Curriculum, and Professional Development. There were also five open response items, seeking to capture teacher perceptions of their learning, the successes and failures of the initiative, and their conceptions of curriculum.

While the district was involved in an overhaul of the entire curriculum, this study focuses upon the events that occurred in secondary (7-12) science only, as a narrow case study. It is hoped that by triangulating the perspectives of the field notes, interview transcriptions, survey results, and the relevant documents, a clear description of the curriculum building process in science will emerge.

Informants

The science teachers involved in this study range from three years to over 20 years in teaching. The ten interview informants include five women and five men, with one informant of color. Seven have worked through several science reform cycles, while three were new to formal curriculum development. Of 36 science teachers directly involved in curriculum writing, 24 responded to a single mailing of a two page survey, for a return rate of 67%.

Data analysis. This data was interrogated with no preconceived coding strategy. Micro-coding (Glesne & Peshkin, 1992; Bogdan & Biklen, 1992) focused on conceptions of the curriculum development process, perceived roles and learning in the process, successes and failures of the effort, and definitions of curriculum. Chi-Square tests (SPSSX, 1997) for qualitative data were used to analyze the Likert scale survey data, with the recognition of the inflated overall experimentwise alpha in running multiple repeated chi-square tests (Witte, 1993).

Results

The results of this study are presented here as a narrative of findings, to discuss the emerging activities and themes of the curriculum development process as experienced by these urban science teachers. The results of the survey are folded within this narrative, as supporting, and not separate data regarding teacher

perceptions of their experiences and their learning. It is hoped that such blending of qualitative and quantitative data results in more robust descriptions of curriculum building and its effects on teachers and teaching.

As we coded and discussed the transcriptions, multiple documents and survey results collected in this study, three important patterns emerged from the data: the organic nature of curriculum development; curriculum defined as both content and pedagogy; and that curriculum development is an important form of staff development. Within these patterns, successes and failures of this reform effort emerge, as well as what teachers learned, and what teachers *did not learn* as a result of their participation in this initiative.

The Emergent Process of Curriculum Development

Interestingly, one pattern which emerged from the data was that no preconceived process of curriculum development was utilized. Rather, informants conceptualized their activities in a more organic (appropriately for science studies!) way. Several teachers noted that "we made it (the process) up as we went along", and described the work as "flying by the seat of our pants as this type of systemic reform has not been done before in this district." Teachers did not appear to be uncomfortable with this assessment. Rather, this appeared to be an appropriate methodology given the context of this effort: a response to local needs for student progress in terms of state mandates and national standards in science. The process appeared to be responsive: as standards for achievement were devised by government and professional organizations, the curriculum team incorporated and adapted objectives to local needs.

This is not to say that no framework was utilized in curriculum development. Review of appropriate documents and the agreement of informants point to a loosely constructed process which had to be revised and reconstructed consistently.. The following is a brief narrative of their three year endeavor based on triangulation of the data.

Informants describe the process as beginning in 1992 with the writing of a seed money grant to NSF to pursue USI funding. A large part of the grant had its purposes in constructing promotion standards for students K-12, making explicit what students should know and be able to do in science at each level, as well as devising activities to enable students to meet those standards.

The city school district received funding for four of the five years proposed in the grant. A core team of teachers selected through a rigorous interview process which utilized the career ladder structure already in place in the district. Teachers were assessed and selected by other teachers in this application process, and removed from classroom duties to focus upon science teaching improvement and serve as curriculum leaders and facilitators. One administrator was appointed to oversee the grant under the districtís Office of Quality Improvement. Thus while teachers were responsible for the daily workings of planning and implementation, there was central office involvement.

The first year of the process (1994) focused upon learning. The USI team utilized this time to explore relevant research, attend conferences and workshops, and obtain guidance from experts in the field, such as Roger Bybee, former head of BSCS and current director of the National Science Standards effort of the National Research Council. Further the team involved science teachers of varying experience and ethnicity from across the district in this exploration and in-service training. The team has continued this education effort far beyond the span of the grant, considering teacher education an integral part of any curriculum development. The effort then, which began in 1992, continues in the 1998-99 school year.

Year Two (1995) of the curriculum building reform consisted of setting up the actual curriculum writing teams and setting standards for what students should know and be able to do in secondary science, as well as a second team charged with formulating an integrated science course where sciences are taught in a thematic way as interrelated disciplines. This second team will be discussed in a later section.

First, writing teams in core science courses was formed by recommendations from the Science Curriculum Council, a body of representatives from each of the schools across the district. Informants described biweekly meetings where groups defined, through consensus, what content knowledge in secondary science courses should be. The science lead teacher, Tom, provided some guidance and texts such as Project 2061(American Association for the Advancement of Science (AAAS), 1989), Benchmarks for Scientific Literacy (AAAS, 1994), and drafts of the not-yet-published The National Science Education Standards (NRC, 1996). The groups also utilized the districtís current science textbooks, the state model curriculum and proficiency test outcomes, as well as a pilot curriculum from BSCS. Safety was added as important in all sciences, and Tom added the nature of science as an important content theme in itself. Teachers described the teams as determining what "processes students should experience, what content, what technology, what writing they should engage." At this point, additional teachers attended meetings intermittently and provided feedback The result of this six month dialogue became the first drafts of middle-level (7-8) promotion standards, and biology and chemistry credit-granting standards which included enabling objectives: processes and content to be pursued to help students meet the standards.

These drafts were sent to all secondary science teachers in the district, and their written feedback was elicited. In addition, several meetings were held to garner general discussion and feedback on the draft standards, after which the writing teams deliberated changes. One meeting invited all biology teachers to a local high school where 11 of 35 district biology teachers attended. A second was limited to science department chairs where 5 of 10 participated. A third was at the human resource development facility and open to all biology and chemistry teachers. Thirty of seventy attended. All teachers were also asked to provide written feedback individually or departmentally following these general meetings. Central office feedback, which was primarily format, was also given. Members of the city community, primarily business leaders in the community serving on an advisory council to the district, also commented on the draft.

The nature of the feedback was primarily language related, with comments on certain topics ranging from "too little to too much". Tom collated the comments and a few significant patterns emerged to which the writing team responded.

Draft documents were also sent to university personnel in education and science to garner external validity. This led to several meetings with university and school people, with criticism centering upon the heavy vocabulary content of the standards, the small number of activity related words in the standards, and the conception that the content to be covered was far too broad and in depth for high school study. It was felt that much of what the committee felt should be taught at the secondary level would be better served at the college level.

This commentary and the resultant collaboration led to a continuous rewriting of the science standards. The result was fewer standards to be achieved, more focus on process than content, utilization of more active vocabulary such as "debate, experiment with, create, draw, build a model of", and less science related vocabulary to manipulate concepts. At this point, the National Science Education Standards (1996) had been published, and this document further informed revision.

Rubrics to assess student achievement of the standards were also formulated beginning in 1996. Rubric writing and revision culminated in the spring of 1996. A week long 20 hour in-service training was provided in the summer of 1996, with writing team members, two USI members, one human resource coordinator, and classroom teachers providing lesson plans and activities to help students meet standards, and to provide modeling in how to utilize standards in unit development. The standards and rubrics, in a sense, appear to be descriptive as opposed to prescriptive. While focusing on what students should know and be able to do, teachers are empowered to select the materials and methodologies utilized to meet these collaboratively developed objectives.

The lead science teacher, Tom, notes that one of the most exciting aspects of this curriculum process occurred in the 1996-97 school year. In his nearly 30 years with this district, no curriculum had been piloted before adoption. These academic standards were given this trial period to, as Tom stated:

> Óget it right. To help teachers understand the standards, how to teach them, to use inquiry, with places during the year for in-service. Though there is really no such thing as getting it right, but ready to implement. This is a time to try things out, before it countsÓ I will know we are ready when teachers understand that these are the essentials to be taught, that we come to some type of consensus, with an understanding that that consensus, like curriculum, must change over time. We need scientifically literate citizens, to help students become productive members of society. We canít write kids off. What will our cities be like?

Teachers echoed this concern for the future as impetus to be involved:

> Students are already on overload. We know that science is in their future, that science is everywhere. But at the same time, I know that of the 120 students I teach, fewer than 10 will go to college. Iíve been doing this 20 years, and thatís a fact. I wanted to develop what students will use in there lives. Some standards just arenít relevant for them beyond the 2 (minimum) level, but ones they will need at the maximum (4).

It appears that the structure of this curriculum allows teachers to meet the needs of their students and yet meet their responsibility to the discipline and to society. It appears that the standard/rubric system is appropriate for a large urban system with a diversity of students. It also appears that the emergent curriculum development process garnered feedback from a variety of stakeholders with an implicit assumption that as deliverers of instruction, classroom teachers must be the most intimately involved. Informants note that the physics curriculum writing team process begun in 1997 and the anatomy writing team process begun in 1998 moved along much more quickly, as they utilized many of the strategies developed by the biology and chemistry teachers. Interestingly, two stakeholders noticeably absent from this process were: students and their parents.

<u>Successes of the curriculum reform effort.</u> Teachers overwhelmingly reported that the success of this initiative lies in the articulation of district-wide curriculum standards for what students should know and be able to do in science. This was especially important to teachers given the high mobility rate of students within the district.

Further, teachers felt that the standards-based curriculum held both teachers and students more accountable for learning, and that the standards clearly articulated what students must know and do to pass a course. One teacher credited the process with:

> Making teachers accountable to a definite standard in the curriculum. We can no longer teach a topic and ignore another because of personal preference...making students accountable to a standard in a subject area...educating teachers about standard-based curriculum...supporting teachers as they move toward standards-based education.

Another success of the standards appears to be its correlation with national and state reform efforts, as well as demanding that all students have equitable opportunities to learn. This provides a curriculum that:

> ...correlates with both our state standards and national standards in science. This correlation better prepares our students to meet the demands of their future. This curriculum is designed in such a way that it provides for the teacher the ability to move the student through enablers with the end result the successful attainment of the standard. It is very teacher friendly. The ...curriculum provides the teacher with the final goal (standard). It does not dictate to the teacher what activities to use to meet the standard. The teacher has the freedom to make choices based on the needs of his/her student population.

It is interesting to note that this perception of standards as descriptive and not prescriptive echoes the proposal of the <u>National Science Education Standards</u> (NRC, 1996).

A final area where teachers perceived success in this reform effort was in the area of teacher professionalism and networking. The standards-based curriculum was written by teachers, for teachers and their students. The curriculum building process provided a vehicle for the sharing of ideas, activities, and philosophies in the teaching of science. Teachers also came to a very broad-based consensus regarding what is important for students to know, and utilized each other as resources. At some point in the process, *every science teacher in the district was invited to join this dialogue and contribute to the discussion and writing of the district standards.* This is noted by teachers as unique to this current effort. In the past, "only a few teachers were involved in the process. Now no one has any reason to complain (but they still do)."

Gains in content knowledge and the use of more hands-on inquiry lessons were also reported as successes, but to a lesser degree.

<u>Failures of the curriculum reform effort.</u> Teachers found that the failures of this curriculum building process were the flip-side of its successes: while the district appears to have achieved the articulation of academic standards for all students, and broad-based consensus regarding what students should know and do in science, informants overwhelmingly report that there is a "failure to convince teachers of the value of standards." Teachers describe this failure as not using the standards appropriately, passing students who have not met the standards, and a general attitude that "this too will pass" as other curriculum models have been utilized and discarded. It is pointed out that not all students arrive in classes at the same level, and this makes standard achievement difficult for many students. Teachers ask for more models and specific lessons that will help them to change the way they teach. They point out that change is a lengthy and complex process, and "wefre not there yet." In addition, standards-based curriculum reform is only one of several reform efforts the district is involved in, such as the movement to a program focus for each school, team-based schools, and per pupil budgeting. Teachers complain they are on "change overload." With so many foci, "people are focusing on programs, teams, site-based management, etc. rather than using those to <u>support</u> the academic stuff."

<u>An ongoing effort.</u> As this brief description of the curriculum-building process suggests, teachers perceive this seven year effort as ongoing and emergent. While standards have been written, piloted and revised, teachers are requesting models, support and further dialogue. The district and teacher leaders have responded through quarterly district-wide science inservice in the 1998-99 school year. It is not yet clear whether this will provide the conversations about standards and standards-based teaching that Smagorinsky (1999) deems necessary to implement and sustain this reform.

<u>Conceptions of Curriculum</u>

Interestingly, teachers voiced a dual conception of the nature of curriculum. Curriculum is qualified as not only the what of teaching, but as "how you do it". Teachers conceptualize curriculum as both content and process.

Several teachers are broad in their description, describing the written curriculum- the documents produced, and the unwritten curriculum, that which is actually taught in classrooms. Our job, as curriculum leaders is to align them. One teacher hopes to get to the day where teachers can take activities and adapt them to meet standards. He makes an interesting comment, "How can we get kids to problem solve if teachers canít?"

Overwhelmingly, informants regard content as integral to curriculum, with the importance of a sequencing that content as a course of study or guidelines for study. "How" one facilitates this content is also critical in the data, but to a lesser degree. Emerging is the concept of standards as curriculum, as a guide to impart "knowledge and elicit certain behaviors." This multiple perception suggests that:

> Curriculum means different things to different people. I feel that curriculum, while being a driving force behind what happens in the school, should also be the daily experiences of the student in a particular course. It is the basis for planning, teaching and learning. The reason why we do what we do.

It appears that engagement in the process of curriculum-building has resulted in a more broad definition of curriculum for science teachers in this district. While traditional conceptions of curriculum as content and course of study (McNeil, 1996) remain prevalent, movement toward curriculum as both content and process in the form of standards for student achievement appears to be emerging.

<u>Curriculum Development as Teacher Development</u>

In their discussion of the successes and failures of this ongoing reform effort, an interesting pattern developed: both informants and the documents reviewed conceptualized curriculum development as teacher development. This jives with much of the research on effective staff development (Sparks & Loucks-Horsley, 1990).

Several informants perceived the process in very personal terms: development of strong friendships and sharing materials and methods with other teachers across the district, recognition that much of the work done in their individual classrooms were "on the right path- setting standards for students to achieve, setting high standards. They canít just float by. They have to be it, live it, act and think like a scientist." This confirmation came from colleagues and the documents utilized to formulate standards. It appears a strong learning process occurred.

Others are more broad in their vision of the professional development afforded by curriculum building. The creation of representative writing teams was cited as providing a de facto "teacher study group" and a vehicle for dialogue regarding professional practice. Providing consistent opportunity for district-wide teacher input stimulated growth among a broader base of teachers, and a growing awareness among teachers of a need to change what and how they are teaching .

The integrated science writing team is a case in point. The team chose an already established integrated science curriculum to implement. While the curriculum was ultimately found to be inappropriate for high school students and more fitting for the middle level, this part of the curriculum reform is not perceived as a failure. Rather, this integrated science pilot "changed how people taught, showed teachers how to use inquiry methods in their classes. Eighteen teachers changed."

What the teachers learned. In order to "get at" what teachers learned in both a qualitative and quantitative manner, a survey (Appendix A) was sent to all teachers directly involved in writing the secondary science curriculum (n = 36). Areas studied were: Professional Knowledge, Collegiality, Instruction, Curriculum and Professional Development. Multiple Chi-Square tests of qualitative data (SPSSX, 1997) were run, testing the null hypothesis that the population of teachers shows no preference in selecting whether they agree or disagree that their participation resulted in the named construct. With a response rate of 67%, several avenues of teacher learning as a result of curriculum building are suggested.

Table 1 reports areas where teachers agree that professional development occurred. In the area of professional knowledge, teachers report two areas of significant growth. Teachers increased their knowledge of district science curriculum, and state and national curriculum initiatives. While one could legitimately argue "no surprises there," Smagorinsky (1999) reports that many proposed systemic initiatives never reach local decision makers, let alone those that directly enact such curriculum reform. This high engagement in both local and national conversations about standards by the teachers in this study appears to answer Smagorinskyís call for the type of activity that will make standards-based curriculum a reality.

Two areas of collegiality appear to have been promoted by curriculum work. Teachers report increased interaction with teachers in other schools in the district, and an increased ability to work collaboratively with other teachers. To a lesser degree, teachers report sharing instructional materials and/or ideas $x2$ (1, n=24) = 4.17. $p < .05$. However, this finding is suspect given the inflation of the overall experimentwise alpha by running multiple repeated chi-square tests.

Perhaps the most disappointing yet not surprising finding of this study is that teachers report little direct effect of participation on their instruction. Only one area of instruction is reported as impacted by curriculum building: use of standards-based curriculum in instruction. There is little evidence at the present time to indicate that inquiry lessons and laboratory-based instruction have increased as a result of this initiative.

Teacher learning regarding curriculum appeared to be the most robust construct. Teachers report that the curriculum initiative resulted in important content and process standards to guide instruction, standards which address student needs, and standards that they use to guide instruction. Interestingly, especially given that this initiative occurred in part in response to poor district performance on standardized tests, teachers do not report that these standards will have an effect on student passage of the state science proficiency test.

Teachers appear to have grown professionally in this endeavor, especially in understanding curriculum. To a lesser degree, teachers report an increased ability to deliver instruction that meets student needs $x2$ (1, n=24) = 4.17. $p< .05$. Again this is a weak finding given the alpha inflation, and given the previous responses that indicate little change in instruction. However, this may indicate the beginnings of instructional change, a process that teachers believe is lengthy and complex, and never quite finished.

What teachers did NOT learn. Only two areas of the survey suggested that teachers agreed they did not grow professionally. Teachers resoundingly felt that while they were up to speed on state and national curricula, they were not cognizant of curricula in other districts, or of the science curriculum in the university setting. This suggests further areas of networking for teacher and curriculum development.

By Way of a Conclusion

As no curriculum development process comes to a definitive conclusion, but is rather an ongoing effort, it is difficult to conclude this description. Triangulation of the data appear to point to three relevant aspects of urban school change as evidenced in this case study of secondary curriculum development in a large mid-western school district. First, the process of curriculum development is emergent rather than prescribed. This is consistent with Purvesí (1975) belief that there is no "one size fits all" schema, but rather that the process should be adapted and driven by local concerns within the context of state mandates and professional organization reform efforts. This is clearly in opposition to many of the previous reform efforts in science teaching, which tended to be more top-down in nature, utilizing prescribed curriculum developed in university settings (McNeil, 1996). In addition, stakeholder input is essential as this descriptive study demonstrates, if a useful document is to be produced. It is disturbing to note the lack of student and parent input in this process, and one is forced to wonder how that will affect its implementation.

Second, the data seemed to indicate a dual conception of curriculum, not only what is to be taught, but how the content is to be manipulated. The model developed here, while descriptive as opposed to prescriptive, is highly constructivist in nature, and clearly values inquiry methodology as opposed to didactic lessons. While this mirrors research in effective teaching and state and national reform, one is again forced to wonder how this vision will be translated in the classrooms of traditional teachers. The survey results reported here suggest that while standards appear to have resulted from a broad-based consensus regarding curriculum, whether that curriculum results in change in instruction is not yet clear.

Finally, the third pattern to emerge from the data is the concept that curriculum development is teacher development, that a successful change process is one where both the institution and the individuals within it are transformed by participation in curriculum development. Odden and Anderson (1986; cited in Sparks & Loucks-Horsley, 1990) capture the reciprocal relationship between organization and individual development in this discussion of their research:

When instructional strategies, which aim to improve the skills of individuals were successful, they had significant impact on the schools as organizations. When school strategies which aim to improve schools as organizations, were successful, they had significant impact on individuals. (246)

It is hoped that the curriculum development process herein described will have a positive effect not only on schools and their teachers, but most importantly, upon the students that they serve.

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What Teachers Learned

Construct	x^2	Significance
District curriculum	20.17	.0001
State/National curriculum	13.50	.0002
District collegiality	13.50	.0002
Working collaboratively	10.67	.0010
Sharing materials/ideas	4.17	.0500
Using standards in instruction	13.50	.0002
Important content standards	20.17	.0001
Important process standards	10.67	.0010
Standards address student needs	6.00	.0100
Standards guide instruction	15.69	.0010
Curriculum understanding	8.17	.0040
Instructional delivery	4.17	.0500

What Teachers Did Not Learn

Construct	x^2	Significance
Other district curriculum	10.67	.0010
University curriculum	6.00	.0100

Note: x^2 (1, n=24)

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